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Last tesserae of a fading mosaic: floristic census and forest vegetation survey at Parche di Bilello (south-western Sicily, Italy), a site needing urgent protection measures

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Abstract

This paper illustrates the botanic heritage of Parche di Bilello, a site located in the municipality of Castelvetrano. The study area hosts several woodland fragments dominated by *Olea europaea* var. *sylvestris*, *Quercus suber* and *Quercus ilex*, respectively. According to historical data, these nuclei represent the last remnants of an open forestland which covered a much wider coastal area between Mazara del Vallo and Sciacca until the end of Middle Age. Phytosociological relevés were focused on these forest nuclei, probably the most representative of south-western Sicily, which correspond to three habitats included in the 92/43 EEC Directive (9320, 9330 and 9340, respectively) and represent the final stage of three different edaphic series. Wild olive forests probably dominated on sandy calcareous soils, holm oaks prevailed on steep calcareous and N-exposed slopes. In contrast, cork oaks mostly occurred on sandy subacid soils issuing from pedogenetic processes on palaeodunes. Moreover, field surveys allowed to list 331 vascular plant taxa. Among them, *Linaria multicaulis* subsp. *humilis*, *Orobanche balsensis* and *Serapias orientalis* subsp. *siciliensis* are new to Trapani Province. Detailed information on the current distribution and the synecology of several plant taxa of high biogeographic and conservation interest is also provided. The study site also hosts one habitat of priority interest (6220, i.e. xerophilous Mediterranean perennial grasslands and annual swards) and two species protected by international laws, i.e. the orchid *Ophrys lunulata* and the lichen *Teloschistes chrysophthalmus*. Considering the high value of its natural heritage, this territory deserves the adoption of more effective protection measures. For this reason the authors recommend its inclusion as a new Site of Community Interest within the Sicilian Natura 2000 network.

Keywords

endangered plant species, floristic inventories, forest vegetation, landscape history, nature conservation

Introduction

Italy and Sicily have a long history of nature protection. They host hundreds of protected areas, sites of interest according to 92/43 EEC Directive and important plant areas (Blasi et al. 2010). The implementation and the planning of management and conservation measures within this network is often informed by two-step gap analysis (Scott et al. 1993): the assessment of the extent, health, frequency, connectivity and distribution of the extant protected areas represents the starting point for the identification of knowledge and conservation gaps. These gaps may be filled in a second step by identifying new high priority areas for conservation (Rodrigues et al. 2004), for instance

by focusing on rare or endangered species and/or on habitat types, whose occurrence and distribution is also taken into account for further development of global, national or regional conservation strategies (Vimal et al. 2011).

In this framework, field research remains the main tool to deepen basic knowledge about the biological heritage of fragile and poorly investigated areas where endangered plants and habitats may co-occur. Moreover, the correct identification and the standardised description of rare vegetation units may play a key role in protecting locally endangered plant communities and preserving all the steps of local vegetation series. These actions improve the survival and the natural dynamics between and within the patches of natural and semi-natural habitats rare at the national (Rosati et al. 2007, 2008) or the regional scale (Viciani et al. 2016).

This paper presents the results from a research focused on the vascular flora and the forest vegetation of the locality 'Parche di Bilello'. This site is located between the localities 'Bresciana' and 'Madonna di Trapani' (South), 'Guardiola' (West), 'Atria' (East) and 'Canalotto' (North) and belongs to the municipality of Castelvetrano (Province of Trapani, south-western Sicily) (Figs. 1A–B). During the field survey campaign carried out between 2004 and 2014, also the occurrence and distribution of noteworthy lichens was recorded. Historic information was added in order to provide a more complete picture of the great biological and cultural value of this site.

Location, geology, soil and climate

The study area (Figs. 1C and 2) is located between 65 and 90 m a.s.l. and corresponds to a system of gently sloping hills aligned from west to east. These hills are calcareous sandstone outcrops which survived in the form of semi-natural islands within a 'matrix' of cultivated lands.

The origin of toponym 'Parche di Bilello' remains unclear. On an old map printed by the Istituto Topografico Militare Italiano (ITMI 1872; Fig. 1C), the study site is indicated as 'Le Parche di Belleddu'. Le 'Parche' is almost certainly a mispronunciation of the vernacular Sicilian term 'Li parchi' (= the parks, i.e. the fenced/protected private areas). The study area is currently surrounded by an almost continuous wall made of calcareous sandstone blocks; this wall has been built either to protect its surface against burning and browsing by domestic herbivores or to create a closed hunting reserve for rabbits.

The almost flat coastal landscapes between Sciacca and Marsala are usually called Sciare, a vernacular term which seems to derive from the Arab word 'sha'raa' (= sterile and uncultivated area). Agricultural activities are difficult here due to poor soil availability. The term 'Sciare' has been broadly used to indicate local karst flatlands, characterized by a mosaic of outcropping calcareous rocks and sandy-loamy shallow lithosols supporting a mosaic-like patchwork of thermo-xerophilous vegetation including therophytic swards, perennial dry grasslands, garrigues and low maquis. The Sciare also host several small temporary ponds and rock pools rich in hygrophilous and

Figure 1. Location of the study area with respect to Italian (A) and Sicilian (B) territory; C) the study area and its close surroundings: particular from ITMI (1872, original scale 1:100,000).

aquatic communities. Until mid 1900s the local complex network of humid areas was fed by a rich and shallow aquifer, whose level was progessively lowered by more than 20 m during the last decades due to indiscriminate (and often illegal) water uptake (Bonanno et al. 2000).

According to Lentini and Carbone (2014), most of the Sciare are characterised by lower Pleistocene (1.8–0.8 Ma) marine sediments (the so-called 'Calcareniti di Marsala'), covering the so-called 'Formazione Marnoso-Arenacea della Valle del Belice', made of sandstones with interbedded marl and clay layers which filled this sector of the Sicilian foredeep during mid-upper Pliocene (3.6–1.8 Ma). According to USDA soil taxonomy (Fierotti 1988), most of the coastal plain and low hills between Marsala and Menfi hosts different combinations of lithic xerorthents (lithosols with pH ≥7), typical and/or lithic rhodoxeralphs ('terra rossa', pH <7).

Basing on the available thermo-pluviometric data from the stations of Castelvetrano, Mazara del Vallo and Sciacca, according to Rivas-Martínez bioclimatic classification (Rivas-Martínez et al. 2004) the study area belongs to lower thermo-mediterranean thermotype and upper dry ombrotype (Bazan et al. 2015; Gianguzzi et al. 2016). Mean annual temperatures range between 17.5 and 18.0 °C, and the highest mean monthly temperatures reach 25.5–26 °C (July-August) and never go below 11 °C (January-February). More details on local climatic patterns are provided in Table 1.

Historical evolution of local landscape

The pollen analysis from cores carried out along the south-western coasts of Sicily not far from our study site at Gorgo Basso and Lago Preola (municipality of Mazara del Vallo) allowed to trace the main phases of the evolution of local landscape over last 10,500 years (Tinner et al. 2009; Calò et al. 2012). According to these studies, local

Table 1. Main climatic data obtained from the nearest climatic stations (from Duro et al. 1996). A, local rainfall (mm); B, temperature (°C); AV = average values.

A													
Station	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Year**	**Nb. rainy days**
Campobello di Mazara	71.0	76.4	49.6	53.9	27.7	3.0	1.3	8.8	29.1	81.4	80.9	73.5	556.6	67

B					
Station	**AV of the warmest month**	**AV of the coldest month**	**Annual AV**	**Range between the AV of the warmest and coldest month**	**Absolute max. value**	**Absolute min. value**
Mazara del Vallo	22.3	13.8	18.0	8.5	48.8	-0.1

Figure 2. The site of 'Parche di Bilello' (source: Google Earth). White line = perimeter of the area where the floristic inventory was carried out; its protection as a new Site of Community Interest is here recommended.

forest ecosystems never recovered from a major collapse occurred under Roman rule, i.e. between 200 BC and 200 AD, and another reduction of tree cover eventually occurred some 500–400 years ago.

The study site falls within the wider territory of Birribaida. This toponym, still reported in the already mentioned ITMI (1872; Fig. 1C), probably derives from a settlement built in the Middle Age. In fact, a place called 'Bellumreparum', clearly recalling the Provencal 'Belripayre' (= beautiful shelter), was first mentioned on some documents dating back to the XIII–XIV centuries AD (Bresc 1975, 1986; Sciascia 2002; Bresc and Sciascia 2016), and refers to a fortified residence where the Emperor Frederic II Hohenstaufen used to rest when visiting local hunting estate (Huillard-Bréholles 1860; Bresc 1980; Maurici 1995). During the following centuries, when the toponym was gradually corrupted into 'Perribaida' (Fazello 1560) and 'Berribaida' (Magini 1620), this territory was renowned for the richness of its game (large mammals like wildboars, roe and fallow deers; birds like rock partridges, quails and hazels). Birribaida was probably just a portion of an open and discontinuous forestland, occupying almost continuously the flatlands stretching from the present-day cities of Mazara del Vallo and Sciacca along the coast, the so-called 'Basso Belice' nowadays including the inland territories of Menfi, Campobello di Mazara, Castelvetrano and Partanna (Fig. 3).

Indeed, between 13th and 15th centuries local forest cover underwent substantial reduction and fragmentation. Several notarial documents confirm this; for instance, Bresc-Gautier (1983) reports that already in 1239 the farmers of Sciacca complained with Emperor Frederic II Hohenstaufen for the shortage of wood needed to build ploughs, and Simonsohn (2007) mentions the sale of many dozens of bags of charcoal obtained from the cork oaks of 'Castelvetrano' in the years 1428 and 1429. In the meantime, many marshes and temporary ponds were drained and converted into cultivated lands. The Cistercian monks of Delia were responsible for the drainage of numerous swamps in the fiefs 'Margio' (vernacular name for marsh, temporary pond), 'Fontanelle' (= small springs), and 'Marcita' (= permanent, stagnant water body), toponyms which confirm the locally shallow water table and the high freshwater availability due to a remarkable frequency of springs (Noto 1732). The occurrence of wetlands (Fig. 3) is also confirmed by the occurrence of scattered nuclei of elms (*Ulmus* spp.), poplars (*Populus* spp.) and willows (*Salix* spp.) in the surroundings (G. Salluzzo, *pers. obs.*) by the local frequency of hackberry trees (*Celtis australis*; see Cusumano 1983; Scuderi 2006), and by other toponyms like 'Margio rotondo' (= rounded

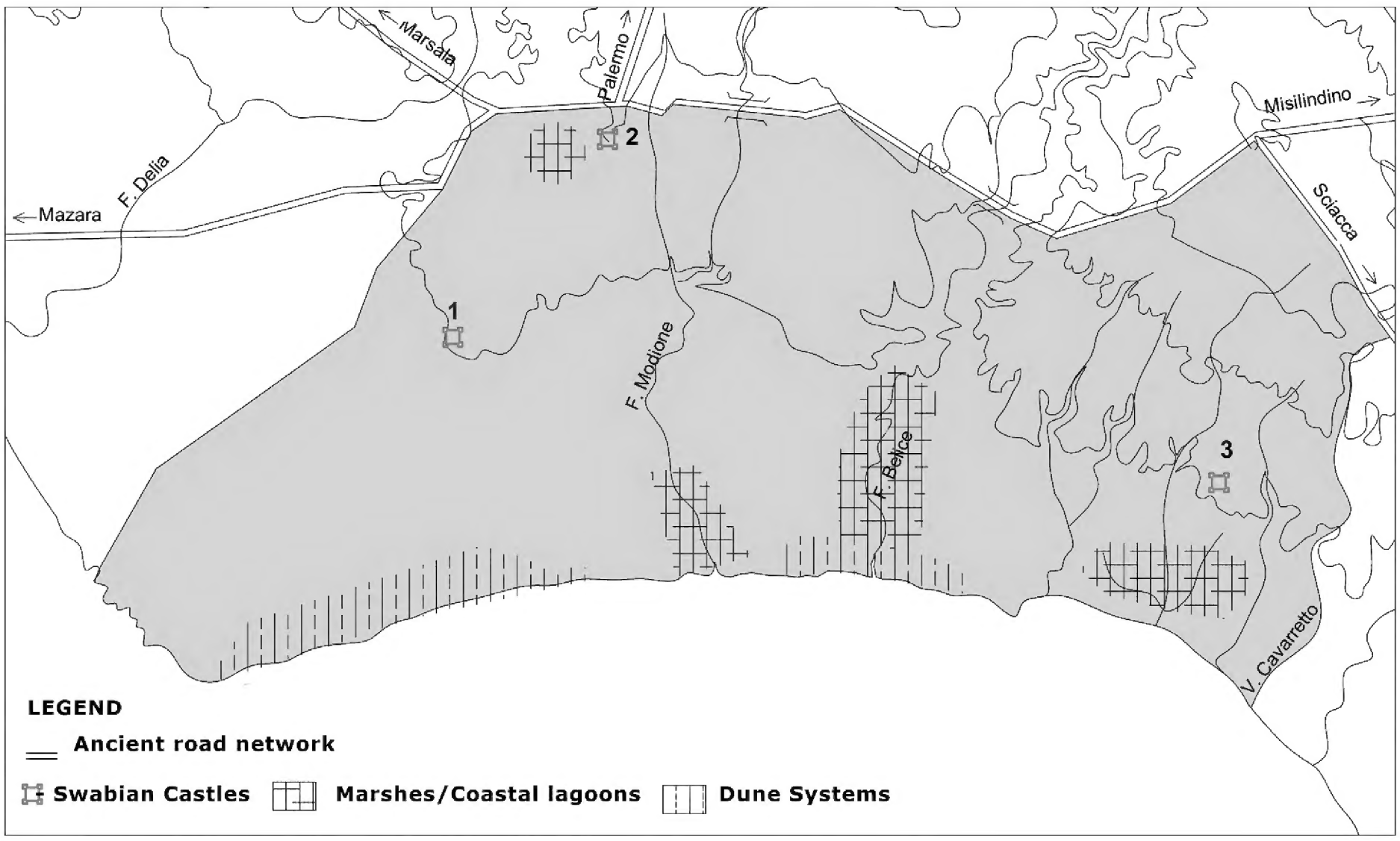

Figure 3. The coastal area between Mazara del Vallo and Menfi during the Middle Ages (from Calamia et al. 2004, modified). The shaded surface coincides with the previous extension of the open forestland of Birribaida; lines refer to 50 and 100 m a.s.l. or to the main local watercourses. As for the Swabian castles, Bellumrepar (1), Bellumvider (2), and Burgimilluso (3), are currently located in the centre of Castelvetrano, Campobello di Mazara and Menfi, respectively.

'margio') and 'Gurra' (a vernacular name referred to willow species) reported in medieval documents (Calamia et al. 2004).

During the XVI century, the noble family Aragona Tagliavia, counts (and since 1564 princes) of Castelvetrano implemented a policy aiming at promoting local agricultural activities by means of mid- to long-term ground leasing contracts (emphyteusis); consequently local farmers could act as temporary land owners and gradually expanded cereal crop fields, vineyards, olive groves to the detriment of local woodland nuclei, and intensified the exploitation of local water for mills and to irrigate sugar cane plantations, rice fields and vegetable gardens (Scalisi 2012). The wide area still hosted some fragments of forest-maquis until the XVIII–XIX centuries AD (Noto 1732; Amico Statella 1759; Bivona-Bernardi 1845; Ferrigno 1931, 1933; Napoli 1932; Titone 1961, Caruso and Nobili 2001), as testified by the numerous local toponyms like 'Bosco della Guardiola', 'Macchia di Lupo', 'Bosco nuovo', 'Bosco di Belice' and 'Bosco Tre Fontane' (Calamia et al. 2004).

History of botanical investigation in the surroundings

The first records concerning the vascular plants growing in the so-called 'Sciare' of Marsala and Mazara date back to Gussone (1827–1832, 1842–1845), Fanales (1899) and Lojacono-Pojero (1889–1909). A general and updated overview on the main botanical features of this territory was provided by Scuderi (2006) and Guarino and Pasta (2017). Moreover, during the last 50 years several papers concerning the vascular flora and the vegetation of the territories of Campobello di Mazara, Mazara del Vallo and Castelvetrano have been published. Most of them were focused on the coastal habitats and wetlands (e.g., Frei 1937; Brullo et al. 1974; Brullo and Ronsisvalle 1975; Brullo and Furnari 1976, 1978; Ronsisvalle 1979; Bartolo and Brullo 1993; La Mantia and Gianguzzi 2003; Ottonello et al. 2003; La Rosa et al. 2007), on local woody communities, namely garrigues and maquis (Brullo and Marcenò 1985; Raimondo et al. 1991; Brullo et al. 1997, 2009), and on grasslands (Catanzaro 1983; Minissale 1995; Brullo et al. 2010). Additionally, many articles focused on/mentioning single species growing in the surroundings have been published during last decades (e.g., Ottonello and Catanzaro 1986; Troia 2006; Troia and Spallino 2009; Geraci et al. 2010; Gianguzzi et al. 2010, 2012; Troia and Raimondo 2010; Badalamenti et al. 2012; Gennai et al. 2015; Médail et al. 2016; Troia and Napolitano 2017; Musarella et al. 2018).

Methods

Lichens identification was carried out by using the analytical keys proposed by Nimis (1987), while their nomenclature follows Nimis and Martellos (2017).

The taxonomic identity, the chorotypes and the life forms of the observed vascular plants follow the second edition of 'Flora d'Italia' (Pignatti et al. 2017–2019), whilst the nomenclature of the listed taxa mainly follows Galasso et al. (2018) and Bartolucci et al. (2018). Alien plants have been classified as 'casual', 'naturalized' or 'invasive' according to their degree of naturalization (Pyšek et al. 2004).

The syntaxonomy of the high rank syntaxa (i.e. alliances, orders and classes) follows the schemes proposed by Biondi et al. (2014) and Mucina et al. (2016), while the associations mainly follow the proposals of Brullo et al. (2002) and Guarino and Pasta (2017).

Forest vegetation was investigated applying the Zurich-Montpellier method (Braun-Blanquet 1964) implemented by Géhu and Rivas-Martínez (1981) and other authors (e.g., Rivas-Martínez 2005; Biondi 2011). Phytosociological relevés were focused on forest nuclei; plot sizes ranged from 80 to 200 m^2 according to the surface of the surveyed forest patches.

Moreover, the evaluation of the biogeographic and conservation interest of local vascular flora was supported by the most updated red-list (Raimondo et al. 2011), floristic inventory (Giardina et al. 2007) and biogeographic overviews (Brullo et al. 1995; Guarino and Pasta 2018) available at regional level.

Some dry specimens of the vascular plants and lichens collected in the study area are stored in the personal herbaria of A. La Rosa, L. Gianguzzi, while many exsiccata of L. Scuderi are deposited in the herbarium of the University of Catania (CAT).

Results and Discussion

Lichens

Field investigations aiming to list all the lichens occurring in the study area are still going on, and the final results will hopefully be published soon in a separate paper. During these surveys, around 50 individuals of an extremely rare lichen, *Teloschistes chrysophthalmus* (L.) Th. Fr. (Fig. 4A), were observed growing on the bark of a wild olive tree. *T. chrysophthalmus* is a fruticose lichen which prefers well lit and moderately nutrient-rich places. It usually colonizes the twigs of small trees and shrubs, and it may also grow on the wooden poles of fences (UK BAP 1999). Even if small-sized, this species is very showy due to the grey-greenish to golden colour of its thallus and the crown of orange cilia surronding its apothecia. *T. chrysophthalmus* is a subcosmopolitan lichen: its distribution range stretches from tropical and sub-tropical to temperate countries on both hemispheres. By contrast, this species has recently experienced a dramatic shrinkage, triggered by air pollution, the indiscriminate use of non-organic fertilisers and the abandonment of extensive fruit-tree orchards (Ravera et al. 2011). As a consequence, it results to be severely endangered in several parts of central and northern Europe

such as in North Italy (Capozzi et al. 2013) and in North Ireland, were it was considered extinct (UK PAB 1999). To contrast this negative trend, special conservation measures have been adopted at the European level, such as the inclusion in the European red list (Serasiaux 1989). In the UK an ad hoc action plan aiming at its safeguard has been implemented, including protecting its preferential habitat (i.e. old fruit tree orchards and hedgerows: UK PAB 1999). Although this species is reported to occur throughout the entire Italian territory, it is very rare in many regions and subject to recent shrinking (Nimis and Martellos 2017). As for Sicily, during recent times the species was only observed in the cork oakwood referred to *Stipo bromoidis-Quercetum suberis* at Santo Pietro near Caltagirone (Capozzi et al. 2013).

General traits of local vascular flora

As much as 331 infrageneric taxa were observed during the field surveys (see Suppl. material 1, Table S1), belonging to 57 plant families, the most common being *Fabaceae* (46 taxa), *Asteraceae* (40), *Poaceae* (35), *Caryophyllaceae* (12), *Apiaceae* (11), *Lamiaceae* and *Orchidaceae* (10). As for the genera, the most represented were *Trifolium* (12 taxa), *Medicago* (7), *Allium*, *Convolvulus* and *Ophrys* (6), *Euphorbia* (5), *Erodium* and *Lotus* (4).

As for life-forms, the study site is characterized by a strong prevalence of annual (T = 170 taxa) and perennial (H = 72; G = 41) herbs and grasses, representing about 85% of total vascular flora. Woody plant list includes 27 phanerophytes, whilst chamaephytes and nano-phanerophytes are both represented by 11 taxa.

The exotic (cultivated, naturalised and invasive) taxa are 13, corresponding to only 3.9% of all the observed vascular plants.

Plants new to the Province of Trapani

LINARIA MULTICAULIS (L.) Mill. subsp. *HUMILIS* (Guss.) De Leon., Giardina & Zizza

This taxon (Fig. 4B) was never recorded before in the province of Trapani. It was previously reported as a narrow-ranged endemic to south-eastern Sicily (Madonna del Piano near Grammichele, Contrada Molara near Caltagirone, Contrada Dirillo near Acate: De Leonardis et al. 1999, 2003). Up to now, only the subsp. *multicaulis* was reported for the 'Sciare di Marsala' (Fanales 1899; confirmed by Scuderi 2006), Trapani and Bonagia (Ponzo 1900) and Alcamo (Ponzo 1903). More recently, subsp. multicaulis has been observed on the western foothills of Monte Cofano (S. Pasta, April 1998, unpubl.), while Scuderi (2006) reports it for Alcamo Marina, the 'sciare' of Campobello di Mazara and Mazara del Vallo, Castelvetrano (Cave di Cusa) and Lago Trinità as a common colonizing the sandy soils of the fossil dunes within the gaps of local shrublands. In south-eastern Sicily this species grows in very similar conditions, dominating local therophytic swards recently framed into the alliance *Filagini asteriscifloraе-Linarion humilis* Minissale & Sciandrello 2015 (order *Malcolmietalia* Rivas Goday 1958).

Local population counts few individuals observed growing in local fallow fields (79 m a.s.l., exposition East, 31.03.2013. A. La Rosa).

OROBANCHE BALSENSIS (J.A.Guim.) Carlón, M.Laínz, Moreno Mor. & O.Sánchez

This taxon (Fig. 4C) was never recorded before in the province of Trapani. Besides Sicily, where it has been reported to grow at Monte Catalfano (Bagheria, Palermo Province) and at Castiglione di Sicilia (Catania Province), the distribution range of this previously neglected taxon includes Spain, Portugal, southern France and Corsica (Carlón et al. 2015). Local population consists of few individuals, parasites on *Carlina sicula* subsp. *sicula* (79 m a.s.l., exposition East, 05.05.2013, A. La Rosa).

SERAPIAS ORIENTALIS (Greuter) H. Baumann & Künkele subsp. *SICILIENSIS* Bartolo & Pulv.

This taxon is new to Trapani province and to western Sicily (Fig. 4D). Originally described from the territory of Niscemi (Caltanissetta Province) by Bartolo and Pulvirenti (1993), so far it was considered to occur only there within open garrigue and grassland communities (Galesi 1996).

Local population counts about 20 individuals, colonizing a grassland patch occupying a gap of local shrubland, dominated by *Cytisus infestus,* referred to the association *Pyro amygdaliformis-Calicotometum infestae* (79 m a.s.l., exposition North, 28.04.2013, A. La Rosa).

Other vascular plants of high biogeographic/conservation interest or poorly known for the Province of Trapani

ACIS AUTUMNALIS (L.) Sweet

The earliest records of this species (Fig. 4E) for the Province of Trapani date back to Gussone (1827), who reported it as growing at Alcamo, Trapani, Marsala and Mazara del Vallo; later on, it was observed near the Gorghi Tondi west of Mazara del Vallo by Lopriore (1900) and near the coast at Trapani (a specimen is still conserved in the herbarium of Palermo, PAL) and in locality Xiggiari near Paceco by Ponzo (1900). More recently, its occurrence has been recorded in the nature reserve of Zingaro (Raimondo and Schicchi 2000; Scuderi 2006), while Scuderi (2006) noticed it in the swards colonising the gaps of grassland and maquis communities of Montagna Grande di Salemi, as well as near Bosco di Scorace between Bruca and Buseto Palizzolo, in Contrada Fastuchera (southwest of Alcamo), and in the forest clearings near the top of Monte Inici (Castellamare del Golfo, L. Scuderi and L. Gianguzzi, unpubl.); it also occurs in the same habitats within the cork oakwood of Angimbè near Calatafimi (C.

Marcenò, October 2015, published in Pignatti et al. 2017–2019). Additional data and photos testifying the occurrence of this species in several localities of the Province of Trapani (Contrada Runza, municipality of Trapani, M. Aleo, October 2017; Gallitello, municipality of Calatafimi, G. Di Gregorio, November 2017; Marsala, G. Donadelli, September 2019; Rilievo, municipality of Trapani, M. Aleo, October 2020) have been published by the members of the forum of 'Acta Plantarum' (https://www.actaplantarum.org/galleria_flora/galleria1.php?view=1&id=2977).

Local population counts few individuals concentrated in semi-shaded surface along a path with one of the forest nuclei referred to *Pistacio lentisci-Quercetum ilicis* (80 m a.s.l., exposition North-East, 14.10.2012, A. La Rosa).

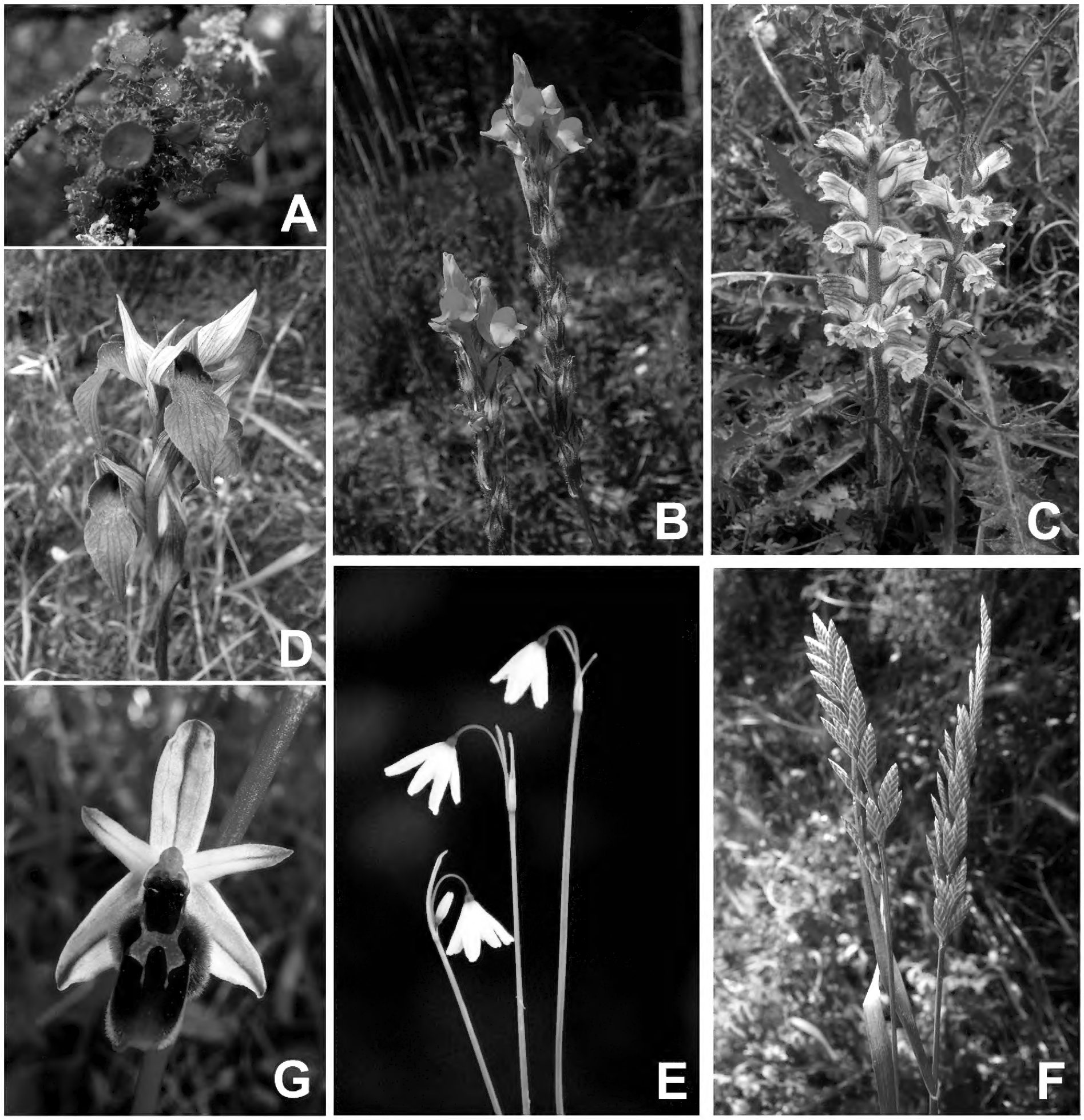

Figure 4. A, *Teloschistes chrysophthalmus* (L.) Th.Fr. (photo: A. La Rosa, February 24, 2013); B, *Linaria multicaulis* (L.) Mill. subsp. *humilis* (Guss.) De Leon., Giardina & Zizza (photo: A. La Rosa, March 31, 2013); C, *Orobanche balsensis* (J.A.Guim.) Carlón, M.Laínz, Moreno Mor. & O.Sánchez (photo: A. La Rosa, May 5, 2013); D, *Serapias orientalis* (Greuter) H.Baumann & Künkele subsp. siciliensis Bartolo & Pulv. (photo: A. La Rosa, April 28 , 2013); E, *Acis autumnalis* (L.) Sweet (photo: L. Gianguzzi, October 13, 2019); F, *Desmazeria sicula* (Jacq.) Dumort. (photo: A. La Rosa, April 20, 2013); G, *Ophrys lunulata* Parl. (photo: A. La Rosa, March 31, 2013).

DESMAZERIA SICULA (Jacq.) Dumort.

Within Trapani Province, this plant (Fig. 4F) grows in the annual therophytic coastal swards between M. Cofano and Bonagia (Ponzo 1900; confirmed here by Barbagallo et al. 1980), Alcamo (Ponzo 1903), Mazara del Vallo (Borzi and Franke in Nicotra and Campagna 1908), Trapani (Todaro in Nicotra and Campagna 1908). This species is featured among the characteristic taxa of the order *Stipo-Bupleuretalia semicompositi* and the alliance *Plantagini-Catapodion balearici* (Brullo 1985; Guarino and Pasta 2017). Lojacono-Pojero (1909) reports the var. monostachya Tineo for the locality 'Macchie di Alcamo'. Its occurrence has been reported also for Isola Lunga (Di Martino and Perrone 1970), San Vito Lo Capo (Bartolo and Brullo 1993). More recently, the species was recorded at San Teodoro in the Lagoon of Marsala and in the nature reserve of Zingaro (Scuderi 2006), at Castello di Pietra between Partanna and Castelvetrano (Scuderi, 2006; Pasta et al. 2008), on Levanzo Island (Romano et al. 2006) and near Torre Grimesi (Mazara del Vallo, L. Scuderi, unpubl.).

Local population counts few individuals growing along the borders of the road that takes to the local 'baglio' (= rural house) (80 m a.s.l., exposition North, 20.04.2013, A. La Rosa).

OPHIOGLOSSUM LUSITANICUM L.

This small fern grows in the annual swards on nutrient-poor sandy soils (*Helianthemion guttati* Br.-Bl in Br.-Bl. & Wagner 1940) or in temporary ponds or seasonally wet rock pools referred to *Cicendion* (Rivas Goday in Rivas Goday & Borja 1961) Br.-Bl. 1967. In the province of Trapani it was first noticed by Gussone (1842–1845) who reported it at Calatafimi, Macchie di Alcamo and the coastal area between Trapani and Mazara del Vallo. It also occurs on Pantelleria Island (Sommier 1907; Médail et al. 2016), along the coast of the Stagnone and on Isola Lunga near Marsala (Brullo et al. 1994; Scuderi 2006), at Monte Cofano (Aleo and Ottonello 2000; Gianguzzi et al. 2005), Contrada San Nicola near Mazara del Vallo (Raimondo et al. 2004). Finally, Médail et al. (2016) reported five more populations, located in Contrada Ballottella (municipality of Trapani), in the temporary ponds of Contrada Anguillara near Calatafimi, in the rock pools of Pietra Colle (an isolated outcropping quartz sandstone rock between Valderice and Buseto Palizzolo) and 'Birribaida'.

More in detail, the population found at Parche di Bilello counts few individuals growing within a bryophytic community colonising a clearing within one of the main forest nuclei (80 m a.s.l., exposition East, 03.02.2013, A. La Rosa).

OPHRYS LUNULATA Parl.

Included in the Appendix I of Washington Convention and in the Appendix II of the 92/43 EU 'Habitats' Directive, this Sicilian endemic occurs almost everywhere in the pasturelands (garrigues, perennial grasslands, open shrubland, thermophilous forest edges) throughout the Sicilian territory, albeit it usually forms small or very small populations. As for its distribution in the Province of Trapani (Fig. 4G), the current knowledge is probably underestimated. Based on published data, local population appears to be the first record for the southern part of Trapani Province. In fact, it was first reported for Monte Inici by Lojacono-Pojero (1909), then for several sites of the Zingaro nature reserve (Raimondo et al. 1986; Raimondo and Schicchi 2000; Scuderi 2006), near Buseto Palizzolo (Raimondo 1987) and for M. Cofano (Campo and Romano 2000; Gianguzzi et al. 2005).

Only three individuals were observed growing in a xeric grasslands along the main road (80 m a.s.l., exposition East, 31.03.2013, A. La Rosa).

Remarks on the non-native plants observed in the study site

Oxalis pes-caprae dominates the winter facies of the weed communities referred to the alliance *Diplotaxion erucoidis* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936 (Brullo and Marcenò 1980; Bernhardt 1986).

The local occurrence of *Galinsoga parviflora* confirms its establishment and spread during last decades. This ruderal thermophilous plant native to North America is listed among the characteristic species of the order *Eragrostietalia* J. Tx. ex Poli 1996 (Mucina et al. 2016), It was observed for the first time in the province of Trapani near Mazara del Vallo by Ottonello and Catanzaro (1986). As for *Chasmanthe floribunda*, probably most (if not all) the previous records for Sicily referred to *Chasmanthe aethiopica* (L.) N.E.Br. should be referred to this alien plant, as recently clarified by Grandis (2016), who reported its occurrence in the province on the base of photos testifying its presence in Pantelleria Island and near Rilievo (municipality of Trapani). This species grows under thermo-mediterranean climate, mostly occurring in sub-ruderal perennial grasslands typical to disturbed road verges and suburban areas and referred to *Bromo-Oryzopsion miliaceae* O. de Bolòs 1970.

Vegetation, land-use and disturbance

This paragraph provides a brief description of the main features of the local landscape (Table 2) and of the disturbances in the territory surrounding the study area. A complete syntaxonomic scheme of the vegetation units observed in the study site and mentioned in the text is provided at the end of the paper.

The main disturbance factors recorded in the study area are wildfires, which frequently affect local vegetation, and the use of non-organic fertilisers and pesticides in the olive groves, citrus orchards and vineyards in the surroundings.

As for the semi-natural plant communities, particular attention has been paid to forest vegetation. Vegetation

Table 2. Soil cover units, phytosociological units and habitats (* = priority) according to 92/43 EU Directive of the study area and the nearby territory.

Soil cover units	Association(s)	Habitats
Climatophilous vegetation of semi-natural areas		
Holm oakwood nuclei	*Pistacio lentisci-Quercetum ilicis*	9340
Cork oakwood nuclei	*Stipo bromoidis-Quercetum suberis* (impoverished)	9330
Dwarf palm-wild olive maquis	*Chamaeropo humilis-Oleetum sylvestris acanthetosum mollis*	9320
Rock-rose garrigues	*Rosmarino-Thymetum capitati*	-
Perennial grasslands	*Hyparrhenietum hirto-pubescentis*	6220*
Annual swards	*Ononido breviflorae-Stipetum capensis, Thero-Sedetum caerulei*	6220*
Hygrophilous vegetation occurring in the watercourses of the nearby territory		
Riparian forests	*Salicetum albo-pedicellatae*	92A0
Scrub of the seasonally dry Mediterranean riverbeds	*Tamarix africana*-dominated community	92D0
Reed meadows	*Phragmitetum communis*	-

relevés (see Tables 3–5) allowed to identify three different communities, i.e. many patches of evergreen maquis dominated by *Olea europaea* var. *sylvestris* and *Chamaerops humilis* and few small remnant nuclei of evergreen forest dominated by *Quercus ilex* or *Quercus suber*.

Several patches of local evergreen sclerophyllous vegetation are dominated by wild olive trees, localised on calcareous sandstone outcrops. These nuclei shall be framed into the *Chamaeropo humilis-Oleetum sylvestris acanthetosum mollis* (Gianguzzi and Bazan 2019; Fig. 5A and Table 3), a tall and usually dense maquis dominated by *Olea europaea* var. *sylvestris* and characterized by many sclerophyllous evergreen small trees, shrubs and subshrubs characteristic of the alliance *Oleo-Ceratonion siliquae*, like *Chamaerops humilis*, *Pistacia lentiscus*, *Rhamnus alaternus*, *Teucrium fruticans*, *Asparagus albus*, *Osyris alba*, several lianas (e.g., *Asparagus acutifolius*, *Clematis cirrhosa*, *Rubia peregrina*, *Smilax aspera*) and geophytes typical to the maquis undergrowth (e.g., *Allium subhirsutum* subsp. *subhirsutum*, *Arisarum vulgare* subsp. *vulgare*). This community may represent the final stage of progressive succession on very nutrient-poor and thin lithosols under dry climatic conditions. The remnant fragments occur on South-exposed slopes on calcareous sandstones and fossil dunes along the coasts of southwestern Sicily (e.g., Sciacca, Menfi, Campobello di Mazara, Mazara del Vallo, Castelvetrano) and near Palermo (northwestern Sicily) between 50 and 300 m a.s.l. (Gianguzzi and Bazan 2019), in close contact with the psammophilous dune communities (*Ammophiletea* Br.-Bl. et Tx. ex Westhoff et al. 1946) and/or with the communities colonizing the rocky shores subject to salt-spray (*Crithmo-Staticetea* Br.-Bl. in Br.-Bl. et al. 1952). Century-long agro-silvo-pastoral activities (forest clearing, overgrazing, wildfires, etc.) were responsible for the deep degradation of local soils, which in turn led to a remarkable regression of the head of series, dominated by *Olea europaea* var. *oleaster*. Consequently, pasturelands prevail in the local mosaic-like landscape, with some nuclei of low maquis dominated by *Chamaerops humilis* (*Pistacio lentisci-Chamaeropetum humilis*), intermingled with perennial xerophilous grasslands (*Hyparrhenietum hirto-pubescentis*) and annual therophytic swards referred to *Ononido breviflorae-Stipetum capensis* and *Thero-Sedetum caerulei*. No phytosociological relevés were carried out in these plant communities, locally represented by small-sized, discontinuous and degraded patches.

Local wild olive forest fragments, referred as habitat 9320 of the 92/43 'Habitats' Directive, are among the best preserved in the entire Sicilian territory (Gianguzzi and Bazan 2019a, 2019b). The high frequency and cover rate of *Oxalis pes-caprae* within these stands are due to the high invasivity of this species, spreading from the surrounding areas characterised by large surfaces devoted to olive cultivation.

Few patches of *Quercus ilex* forest are localized on north-facing slopes; these woodland fragments (Fig. 5B and Table 4) belong to *Pistacio lentisci-Quercetum ilicis* (Brullo and Marcenò 1985; Brullo et al. 2009), an association characterised by the high cover of *Pistacia lentiscus* and evergreen and summer-deciduous small trees and shrubs characteristic of thermophilous maquis communities (order *Pistacio lentisci-Rhamnetalia alaterni*, alliance *Oleo-Ceratonion siliquae*). Another remarkable fragment of this mixed evergreen oakwood is Bosco del Cantarro near the Gorghi Tondi nature reserve, west of Mazara del Vallo. This community may represent the final stage of local progressive succession processes on the thin and base-rich lithosols found on compact limestone bedrocks. First observed in the locality Gorghi Tondi near Mazara del Vallo (Brullo and Ronsisvalle 1975), not far from our study site, this association was described by Brullo and Marcenò (1985) and his presence recorded in several localities of western Sicily, like the coastal area near Palermo (Gianguzzi et al. 1996), the Island of Marettimo (Gianguzzi et al. 2006), the southern sector of the Sicani Mts. (Gianguzzi et al. 2016), as well as the south-eastern Sicily at Bosco di Santo Pietro near Caltagirone and elsewhere in the Hyblaean Plateau and in Sardinia (Bartolo et al. 1992; Brullo et al. 2009). Mostly enjoying cooler microclimatic conditions and sites protected from the warm and dry winds coming from North Africa, under more xeric conditions this community is usually replaced by the thermo-xerophilous maquis communities referred to *Pistacio lentisci-Chamaeropetum humilis*.

Table 3. Dwarf Palm-Wild Olive evergreen sclerophyllous maquis (*Chamaeropo humilis-Oleetum sylvestris acanthetosum mollis*). Relevés 1–5 (L. Gianguzzi, 24.04.2005, in Gianguzzi & Bazan 2019a, Tab. S4 n. 74 and 82–85); relevés 6–9 (L. Gianguzzi, 9.05.2007, in Gianguzzi & Bazan 2019a, Tab. S4 n. 77–78 and 88–87); relevés 10-14 (L. Gianguzzi, 12.05.2014, unpubl.).

Relevé (n°)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Altitude (m)	80	80	86	84	80	76	70	67	65	78	79	81	81	86
Slope (°)	20	30	15	15	15	20	30	25	25	15	5	5	5	7
Aspect	SW	S	E	S	N	E	E	SE	S	E	E	E	E	N
Area (m^2)	120	150	150	150	150	100	100	100	100	100	100	100	100	100
Total cover (%)	100	100	100	95	95	100	100	90	100	100	100	100	100	100
Tree cover (%)	100	100	100	90	90	100	100	20	100	100	95	100	100	40
Shrub cover (%)	100	100	100	90	90	100	100	80	100	100	95	100	100	70
Herbaceous cover (%)	40	40	40	40	40	40	40	30	20	30	25	20	20	15
Average heigth of the dominant layer (m)	6	6	5	3,5	4	5	7	3,5	5	6	6	5	5	7
Species per relevé	17	17	18	20	17	21	23	22	21	20	22	22	19	21
Char. and diff. of association and subassociation														
Olea europaea L. var. *sylvestris* (Mill.) Lehr	5	5	4	5	4	5	5	5	5	5	5	5	4	5
Acanthus mollis L. subsp. *mollis*	2	3	2	1	+	3	3	1	2	1	+	1	1	1
Chamaerops humilis L.	+	1	1	1	1	1	1	1	1	.	.	1	1	+
Rhamnus alaternus L. subsp. *alaternus*	.	.	1	.	+	.	.	.	1	+	1	2	2	.
Char. of alliance and order														
Pistacia lentiscus L.	2	2	3	3	3	3	3	2	2	3	3	2	3	3
Stachys major (L.) Bartolucci & Peruzzi	+	+	1	1	2	1	+	1	1	.	1	+	1	1
Allium subhirsutum L. subsp. *subhirsutum*	1	1	1	1	.	1	1	+	.	+	+	.	1	.
Asparagus albus L.	1	1	+	.	1	.	.	1	1	1	1	+	+	.
Clematis cirrhosa L.	2	1	1	+	+	.	+	.	.	+	.	.	.	.
Anagyris foetida L.	.	.	1	1	.	2	.	2	.	.	.	1	2	1
Cytisus infestus (C.Presl) Guss. subsp. *infestus*	.	.	1	.	.	+	.	1	.	.	1	+	1	1
Teucrium fruticans L. subsp. *fruticans*	.	.	.	1	2	.	.	.	.	+	2	.	.	.
Myrtus communis L.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Ceratonia siliqua L.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Rhamnus lycioides subsp. *oleoides* (L.) Jahand. & Maire	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Char. of class *Quercetea ilicis*														
Smilax aspera L.	2	2	3	+	1	3	3	+	2	1	1	3	2	1
Asparagus acutifolius L.	1	1	1	1	+	1	1	1	1	1	1	1	.	+
Rubia peregrina L.	1	1	1	1	1	.	+	1	1	1	1	1	1	1
Arisarum vulgare O.Targ.Tozz. subsp. *vulgare*	+	1	1	1	+	1	.	+	1	+	+	.	1	+
Daphne gnidium L.	+	.	1	.	+	.	+	.	.	.	+	+	.	+
Ampelodesmos mauritanicus (Poir.) T.Durand & Schinz	.	.	+	1	.	+	1	+	.	.	.	.	+	.
Rosa sempervirens L.	.	.	.	.	.	+	2	+	+	+	.	.	.	.
Quercus suber L.	.	.	.	.	.	.	.	.	1	1	1	.	.	.
Osyris alba L.	.	.	.	.	.	.	.	.	.	1	.	+	.	+
Celtis australis L. subsp. *australis*	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Pyrus spinosa Forssk.	.	.	.	.	.	+	1	.	.	.	.	.	.	.
Phillyrea latifolia L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Other species														
Oxalis pes-caprae L.	3	2	2	3	3	2	+	1	+	2	+	+	1	.
Oloptum miliaceum (L.) Röser & H.R.Hamasha	+	.	.	1	.	+	+	1	+	+	+	+	.	+
Geranium purpureum L.	.	+	.	+	2	+	.	.	.	.	2	1	1	+
Hyparrhenia hirta (L.) Stapf subsp. *hirta*	+	+	.	.	.	.	+	1	+	.	+	.	.	.
Capparis spinosa L.	.	+	.	+	1	.	.	+	.	.	.	.	+	+
Asphodelus ramosus L. subsp. *ramosus*	.	+	.	+	.	.	.	.	+	+	.	+	.	+
Mercurialis annua L.	+	.	.	.	.	+	.	.	+	.	1	+	.	.
Ferula communis L. subsp. *communis*	.	.	.	.	.	.	+	1	.	1	.	.	.	+
Charybdis pancration (Steinh.) Speta	.	.	.	.	.	.	.	+	.	.	+	+	+	.
Smyrnium olusatrum L.	.	.	+	1	.	.	.	.	+	.	.	.	.	.
Brachypodium retusum (Pers.) P.Beauv.	.	.	.	.	+	+	+	.	.	.	.	.	.	.
Silene latifolia Poir.	.	.	.	.	.	+	+	.	1	.	.	.	.	.
Rubus ulmifolius Schott	.	.	.	.	.	1	1	.	.	.	.	.	.	.
Kundmannia sicula (L.) DC.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Umbilicus horizontalis (Guss.) DC.	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Magydaris pastinacea (Lam.) Paol.	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Cistus creticus subsp. *creticus*	.	.	.	.	.	.	.	.	.	.	.	+	.	1
Bituminaria bituminosa (L.) E.H.Stirt.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Crataegus monogyna Jacq.	.	.	.	.	.	.	1	.	.	.	.	.	.	.

Although severely degraded and floristically impoverished, some cork oak wood nuclei still survive in the study area, forming linear features along dry stone walls and hedges which probably correspond to the past borders of the fief. These forest fragments host some majestic (more than 1 m of diameter at breast height: Fig. 5C) and very old individuals of *Quercus suber* L., and may be interpreted as an impoverished feature (Fig. 5D and Table 5) of *Stipo bromoidis-Quercetum suberis*, an open forest community described from the Erei Mounts (southeastern Sicily: Barbagallo 1983; Brullo et al. 2009 and references therein). Even if the main characteristic species of this association, i.e. *Aristella bromoides* (L.) Bertol. – also known as *Stipa bromoides* L. – was not observed in the study area, it has been recently reported to occur at Menfi and Castelvetrano (Scuderi and Pasta 2009) in other remnant fragments of open forestland once covering the Basso Belice lowland (see Table 6, relevé 3, from Scuderi 2006).

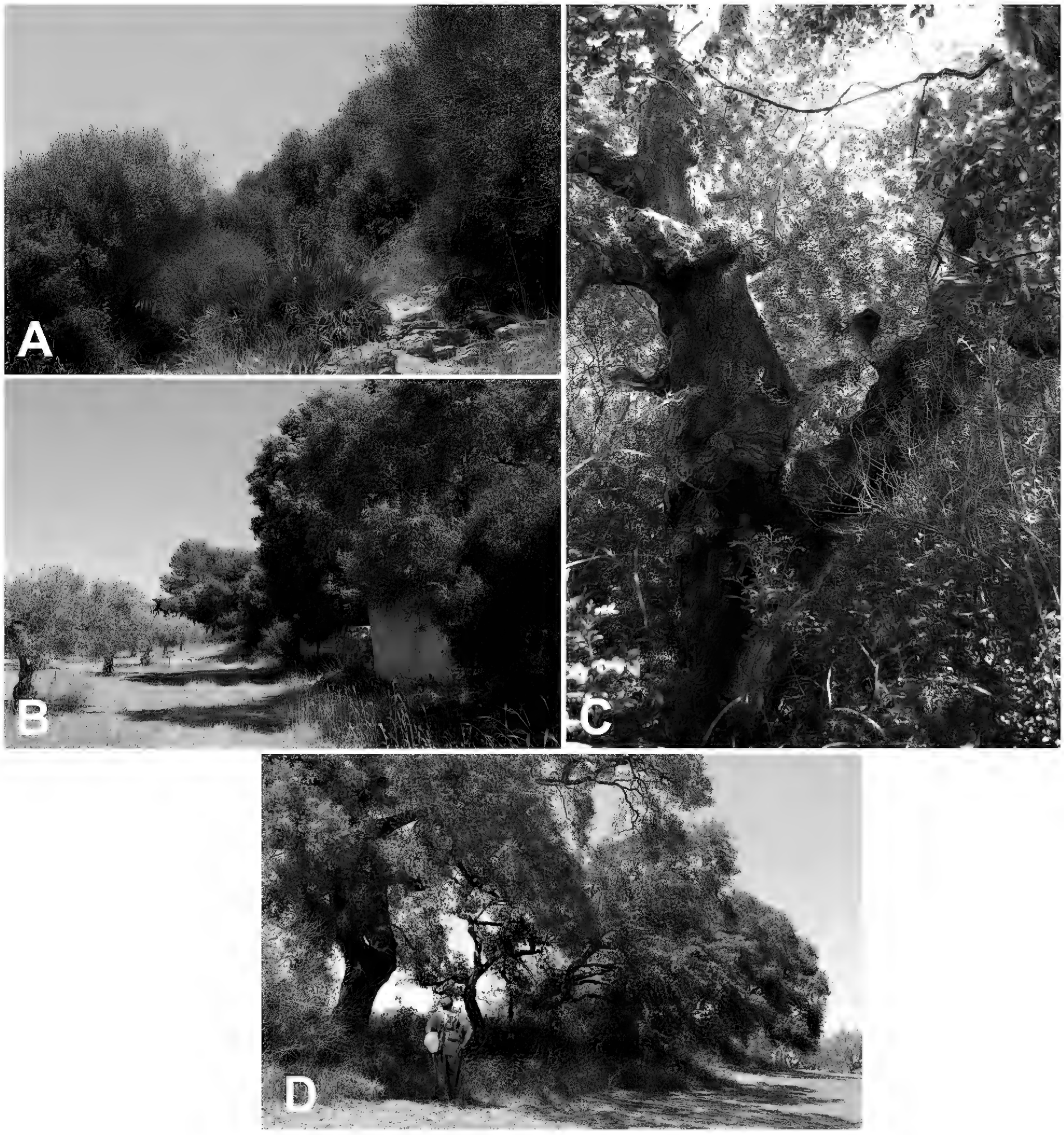

Figure 5. A, Evegreen maquis-forest nucleus referred to the *Chamaeropo humilis-Oleetum sylvestris acanthetosum mollis* (Habitat 9320) (photo: L. Gianguzzi, May 9, 2007); B, Forest nucleus dominated by *Quercus ilex* (Habitat 9340) (photo: L. Gianguzzi, May 9, 2007); C, Century-old tree of *Quercus suber* (photo: L. Gianguzzi, May 9, 2007); D, Forest strip dominated by *Quercus suber* (Habitat 9330) (photo: L. Gianguzzi, May 9, 2007).

Local fragments of *Quercus suber* woods probably represented the final stage on local well-drained and mostly sandy-loamy soils on palaeodunes. This head of serieshas been wiped out little by little to give room to vineyards and olive groves over wide areas of the surrounding territory. The degradation of cork oakwoods usually leads to the spread of a patchy landscape made of broom-dominated shrublands referred to *Pyro amygdaliformis-Calicotometum infestae* – locally very rare due to the century-lasting removal of fuelwood – and garrigues (*Rosmarino-Thymetum capitati*) intermingled with perennial grasslands (*Hyparrhenietum hirto-pubescentis*) and annual therophytic swards belonging to *Helianthemetea guttati* Rivas Goday & Rivas-Mart. 1963). Like in the Erei territory (e.g., Niscemi, Caltagirone), on the deeper soils of the innermost part of southwestern Sicily such cork oak forests might have occurred in close contact with thermophilous woodlands dominated by *Quercus pubescens* s.l.. Downy oaks have completely disappeared from the whole territory, with the only exception of few remarkable isolated individuals growing in the bottom of the canyon of Castello di Pietra (Pasta et al. 2008) and of some little forest nuclei located in the bottom of Vallone San Vincenzo near Menfi (M. Buffa and S. Pasta, April 1994, unpubl.) and on a north-west-facing slope near the River Modione along the road connecting Partanna and Castelvetrano (Lat. 37°41'00.9" N, Long. 12°49'49.1" E, A. Troia, pers. comm.).

With regards to the taxonomic value of *Q. virgiliana* as well as of various other taxa belonging to the collective group of *Q. pubescens* Willd., widely reported for Sicily and southern Italy in the last decades, a lively scientific debate is still going on (see Wellstein & Spada 2015; Pasta et al. 2016; Pignatti et al. 2017; Di Pietro et al. 2020, 2021).

Ancient floras suggest that until few centuries ago *Q. pubescens* s.l. was more common than today in the lowlands and near the coastline, while the few avaialable data on vegetation dynamics after the abandonment of cork production (Di Benedetto et al. 1985; Di Pasquale and Garfì, 1998; Rühl et al. 2005; La Mela et al. 2007) and several co-occurrence data support the hypothesis that mixed cork oak/downy oak woodlands may have formed large forests in the thermo- and meso-Mediterranean belts of Sicily. Indeed, *Q. pubescens* s.l.-dominated forests probably represented a more common feature on clayey acid soils (e.g., Cullotta & Pasta 2004; Gianguzzi 2004; Gianguzzi et al. 2015), but underwent deep shrinkage as a result of century-long agropastoral activities.

At present, very few data were available on the occurrence of cork oak in the north-western and western Sicily (Gianguzzi et al. 2008; Badalamenti et al. 2020). As for the Tyrrhenian sector of the province of Trapani, *Q. suber* has been reported to occur only in few scattered forest/shrubland stands, such as the 'macchie' of Alcamo (Ponzo 1903; Borzì 1911), in locality Bosco Scorace/Arcodaci in the municipality of Buseto Palizzolo (Adragna 1976; Raimondo 1979), in the nature reserve of Zingaro in the municipalities of Castellamare del Golfo and San Vito Lo Capo (Scuderi et al. 1994), at Bosco di Angimbé in the municipality of Calatafimi (Marguglio 1973; Scuderi 2006), on the slopes of Mt. Ferricini, west of Alcamo, (Scuderi 2006) and near the top of Mt. Inici in the municipality of Castellamare del Golfo (Scuderi 2006), where it was introduced after the Second World War and is now successfully established (Colomela et al. 2012).

Although south-western Sicily is correctly included in both the potential (Vessella and Schirone 2013) and the current (Pasta et al. 2000; EUFORGEN; Agrillo et al. 2018) distribution range of *Q. suber*, the information available about the distribution of local cork oak stands is extremely poor and need to be clarified. As for the area corresponding to the ancient forest of Birribaida, several neglected or unpublished occurrence data should be

Table 4. Holm oak wood stands (*Pistacio lentisci-Quercetum ilicis*). Relevés 1–2 (L. Gianguzzi, 9.05.2007, unpubl.).

Relevé (n°)	1	2
Altitude (m)	73	75
Slope (°)	20	15
Aspect	N	N
Area (m²)	100	100
Total cover (%)	100	80
Tree cover (%)	100	100
Scrub cover (%)	30	60
Herbaceous cover (%)	20	5
Average heigth of the dominant layer (m)	7.5	7.0
Species per relevé	26	21
Char. association		
Quercus ilex L.	5	5
Pistacia lentiscus L.	3	4
Chamaerops humilis L.	+	1
Asparagus albus L.	+	.
Char. alliance (*Fraxino-Quercion ilicis*), order (*Quercetalia ilicis*) and class *Quercetea ilicis*		
Smilax aspera L.	2	3
Olea europaea L. var. *sylvestris* (Mill.) Lehr	2	1
Phillyrea latifolia L.	2	1
Clematis cirrhosa L.	2	1
Rhamnus alaternus L. subsp. *alaternus*	1	2
Arisarum vulgare O.Targ.Tozz. subsp. *vulgare*	1	2
Rubia peregrina L.	1	2
Quercus suber L.	1	2
Pistacia lentiscus L.	1	1
Asparagus acutifolius L.	1	1
Allium subhirsutum L. subsp. *subhirsutum*	1	+
Stachys major (L.) Bartolucci & Peruzzi	+	.
Osyris alba L.	+	.
Daphne gnidium L.	+	.
Ampelodesmos mauritanicus (Poir.) T.Durand & Schinz	+	.
Teucrium fruticans L. subsp. *fruticans*	.	+
Other species		
Acanthus mollis L. subsp. *mollis*	2	3
Smyrnium olusatrum L.	2	+
Oxalis pes-caprae L.	1	1
Crataegus monogyna Jacq.	1	+
Oloptum miliaceum (L.) Röser & H.R.Hamasha	1	+
Asphodelus ramosus L. subsp. *ramosus*	+	+
Stellaria neglecta Weihe subsp. *cupaniana* (Jord. & Fourr.) Gutermann	+	.
Silene latifolia Poir.	+	.

Table 5. Degraded cork oak stands (*Stipo bromoidis-Quercetum suberis*) of Parche di Bilello (Relevés 1–2: L. Gianguzzi, 9.05.2007, unpubl.) and adjacent areas (Relevé 3: L. Scuderi, Locality Bresciana, municipality of Castelvetrano, 7.06.2005; cf. Scuderi, 2006).

Relevé (n°)	1	2	3
Altitude (m)	77	80	48
Slope (°)	5	2	2
Aspect	N	N	S
Area (m^2)	100	100	200
Total cover (%)	100	90	80
Tree cover (%)	95	90	80
Scrub cover (%)	70	60	60
Herbaceous cover (%)	40	45	40
Average heigth of the dominant layer (m)	7.5	8.0	7.0
Species per relevé	19	15	19
Char. of association and alliance *Erico arboreae-Quercion ilicis*			
Quercus suber L.	5	5	4
Myrtus communis L.	.	.	1
Aristella bromoides (L.) Bertol.	.	.	+
Char. order *Quercetalia ilicis* and class *Quercetea ilicis*			
Smilax aspera L.	3	2	2
Pistacia lentiscus L.	2	2	2
Rosa sempervirens L.	1	2	2
Olea europaea L. var. *sylvestris* (Mill.) Lehr	2	1	1
Rubia peregrina L.	2	1	1
Allium subhirsutum L. subsp. *subhirsutum*	1	+	1
Stachys major (L.) Bartolucci & Peruzzi	1	+	+
Asparagus acutifolius L.	1	2	+
Arisarum vulgare O.Targ.Tozz. subsp. *vulgare*	+	1	.
Rhamnus alaternus L. subsp. *alaternus*	1	.	.
Asparagus albus L.	1	.	.
Quercus ilex L.	+	.	.
Chamaerops humilis L.	.	+	.
Carex divulsa Stokes	.	.	+
Other species			
Acanthus mollis L. subsp. *mollis*	2	1	.
Geranium purpureum L.	+	+	.
Euphorbia ceratocarpa Ten.	1	.	1
Hyparrhenia hirta (L.) Stapf subsp. *hirta*	1	.	1
Oloptum miliaceum (L.) Röser & H.R.Hamasha	+	.	2
Rubus ulmifolius Schott	.	1	1
Silene latifolia Poir.	+	.	.
Smyrnium olusatrum L.	.	+	.
Crataegus monogyna Jacq.	.	.	1
Cistus creticus L. subsp. *eriocephalus* (Viv.) Greuter & Burdet	.	.	+
Solanum villosum Mill.	.	.	+

added to those concerning localities Parche di Bilello and Bresciana (Table 6). In fact, cork oaks were noticed growing near Sciacca by J. W. Goethe in April 1787 during his travel across Sicily (Goethe 1813–1817), and the occurrence of the toponym 'Suvarito' on the map 'Sciacca' (IGMI 1973) suggests that *Q. suber* may have only recently gone extinct. In fact, cork oaks old records were also reported for Castelvetrano (De Stefani-Perez 1898). An additional indirect hint about the presence and the exploitation of *Q. suber* in the study area is the fact that cork dishes were part of the daily equipment of the countrymen of the Belice area until 1970s (Cusumano 1978).

Additionally, small stands and isolated trees of *Q. suber* still occur along the roadsides of the ancient Feudo (= fiefdom) of Dimina between Castelvetrano and Partanna (Pasta et al. 2008), between Castelvetrano and Menfi (S. Pasta and S. Mattana, August 1998, unpubl.), as well as near Marinella di Selinunte (37°37'03" N, 12°51'10" E) and between Triscina and Parche di Bilello (Lat. 37°36'44.3" N, Long. 12°47'50.6" E, A. Troia, pers. comm.).

Biogeographic remarks

The discovery of *Linaria multicaulis* subsp. *humilis* and *Serapias orientalis* subsp. *siciliensis*, discussed in the present paper, together with the recent finding of *Retama raetam* (Forssk.) Webb subsp. *gussonei* (Webb) W. Greuter (Troia and Spallino 2009), *Aristella bromoides* and *Tuberaria villosissima* (Pomel) Grosser subsp. *sicula* (Grosser) Bartolo, Pulvirenti et Salmeri (Scuderi and Pasta 2009) underlines the strong floristic similarity between the coastal lowlands (sciare) of southwestern Sicily, stretching from Marsala to Sciacca, and those of southeastern Sicily (including the territories of Comiso, Gela, Vittoria, Camarina, Caltagirone, Niscemi, Mazzarino, etc.). This latter area roughly coincides with the 'Kamarino-Pachynense' district, identified by Brullo et al. (1995), which probably does not deserve to be treated as a separate biogeographic unit, considering the very recent emersion of these lands (Mid to Upper Pleistocene) and the few plant taxa which result to grow exclusively there.

Conclusions

As already highlighted by Raimondo et al. (2005) and Scuderi and Pasta (2009), the Province of Trapani is well, yet unevenly studied. Recent field surveys carried out in this territory allowed to find species new to science (e.g., Troia and Raimondo 2010) and to confirm the regional occurrence of very rare and globally endangered ones (e.g., Troia and Lansdown 2016). The improvement of the knowledge involves the need for more appropriate conservation measures to prevent the last populations of several vulnerable and legally protected species and habitats from being wiped out due to severe land-use intensification. For these reasons, taking into account not only the occurrence of a rare lichen of conservation interest (*Teloschistes chrysophthalmus*), but also considering the presence of a vascular plant of Community priority interest (*Ophrys lunulata*) and of several habitats (6220*, 9320, 9330, 9340) of Community interest according to 92/43 EU 'Habitats' Directive (Table 6), we strongly recommend the institution of a new Site of Community Importance (SCI) to protect the site of Parche di Bilello, or to re-shape the ones already existing in the nearbies, a strategy which has already been adopted during last years in the Province of Trapani (Troia et al. 2011, 2016).

On this purpose, we should underline that our study area is not far from the River Modione. This watercourse which still hosts several fragments of riparian forest re-

Table 6. Lichens, Vascular plants and habitat types of high biogeographic/conservation interest occurring at Parche di Bilello. Since 1995 all the European Orchids are included within the Appendix I of CITES. * = species listed in the Appendixes or habitat of priority interest according to 92/43 EU Directive.

Taxon	Endemic	Narrow Range	Protected/ Red-Listed	Other Criteria
Acis autumnalis				x
Allium obtusiflorum	x			
Ambrosina bassii			x	
Anacamptis papilionacea subsp. *grandiflora*			x	
Barlia robertiana			x	
Carlina sicula subsp. *sicula*	x			
Desmazeria sicula				x
Echium italicum subsp. *siculum*	x			
Euphorbia ceratocarpa.		x		
Linaria multicaulis subsp. *humilis*	x			x
Ophioglossum lusitanicum			x	x
Ophrys apifera			x	
Ophrys lunulata	x		*	x
Ophrys lutea subsp. *lutea*			x	
Ophrys sicula			x	
Ophrys speculum			x	
Ophrys tenthredinifera subsp. *grandiflora*		x	x	
Orobanche balsensis				x
Pimpinella anisoides		x		
Serapias orientalis subsp. *siciliensis*	x		x	x
Tragopogon cupanii		x		
Habitats of the 92/43 EU Directive occurring in the study area	**Endemic**	**Narrow Range**	**Protected/ Red-Listed**	**Other Criteria**
6220			*	
9320			x	x
9330			x	x
9340			x	
Habitats of the 92/43 EU Directive occurring in the nearby territory	**Endemic**	**Narrow Range**	**Protected/ Red-Listed**	**Other Criteria**
92A0			x	
92D0			x	

ferred to *Salicetum albo-pedicellatae* (*Salicion albae*). Moreover, several spots of thermo-hygrophilous scrub (*Tamarix africana*-dominated community) occur on the seasonally dry beds and the riversides of this river, while reed meadows (*Phragmitetum communis*) colonize its thalweg (data not shown). All these data suggest to promote a more comprehensive investigation of the size, importance and distribution of other patches of semi-natural habitats testifying for the previous extension of local woodlands and riparian forests. For instance, taking into account a wider portion of the territory may allow to produce a more articulated proposal for the institution of a new site of Community interest or to create the ecological corridors needed to connect the site of Parche di Bilello with an already existing hub of the Sicilian Natura 2000 network, i.e. ITA010005 'Laghetti di Preola e Gorghi Tondi e Sciare di Mazara', located within a 15 km radius from our study area.

The study area worths to be protected and valorized for the high symbolic value of the last remnant nuclei of forest vegetation, especially considering that the Parche di Bilello host the best conserved nuclei of wild olive forests occurring in the entire province of Trapani and the last fragments of cork oak woods referred to *Stipo bromoidis-Quercetum suberis*, completely wiped out from the whole south-western Sicily. Since 2014 the management of the study area is under the responsibility of the ONG 'Cooperativa Sociale Onlus Rita Atria-Libera Terra', aiming at promoting legality and traditional extensive agricultural practices. A best practice could be to assign to this ONG the role of guardian of this area, representing a precious tile survived to the destruction of the past coastal woodland/shrubland/grassland mosaic.

The presence of bifacial pebble tools, probably dating back to Mesolithic and testifying for the long-lasting history of local human presence, has been reported for the study area (Leighton 1999; Lo Vetro and Martini 2012). As a consequence, Parche di Bilello also features among the sites of archaeological interest (Regione Siciliana 2018) according to article 142 (letter 'm') of the Decree 42 of year 2004 published by the Sicilian Regional Authority. The co-occurrence of cultural and natural heritage in the same area, a frequent feature in Mediterranean areas, should be viewed - here as elsewhere - as a chance to support the proposal of strengthening the conservation measures for this site.

Syntaxonomic scheme

QUERCETEA ILICIS Br.-Bl. ex A. Bolòs et O. de Bolòs in A. Bolòs y Vayreda 1950
QUERCETALIA ILICIS Br.-Bl. ex Molinier 1934
Fraxino orni-Quercion ilicis Biondi, Casavecchia et Gigante in Biondi et al. 2013
Pistacio lentisci-Quercetum ilicis Brullo et Marcenò 1985
Erico arboreae-Quercion ilicis S. Brullo, De Martino et Marcenò 1977
Stipo bromoidis-Quercetum suberis Barbagallo 1983
PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas-Martínez 1975
Oleo sylvestris-Ceratonion siliquae Br.-Bl. 1936 em. Rivas-Martínez 1975
Pistacio lentisci-Chamaeropetum humilis Brullo et Marcenò 1985
Chamaeropo humilis-Oleetum sylvestris acanthetosum mollis Gianguzzi et Bazan 2019
Pyro amygdaliformis-Calicotometum infestae Gianguzzi et La Mantia 2008

ONONIDO-ROSMARINETEA Br.-Bl. in A. Bolos y Vayreda 1950
ROSMARINETALIA OFFICIALIS Br.-Bl. ex Molinier 1934
Cisto eriocephali-Ericion multiflorae Biondi 2000
Rosmarino officinalis-Thymetum capitati Furnari 1965

LYGEO SPARTI-STIPETEA TENACISSIMAE Rivas-Martínez 1978
CYMBOPOGONO-BRACHYPODIETALIA RAMOSI Horvatic1963
Hyparrhenion hirtae Br.-Bl., P. Silva et Rozeira 1956
Hyparrhenietum hirto-pubescentis A.et O. de Bolòs et Br.-Bl. in A. et O.Bolòs 1950

STIPO-TRACHYNIETEA DISTACHYAE Brullo in Brullo, Scelsi et Spampinato 2001
BRACHYPODIETALIA DISTACHYI Rivas-Martínez 1978
Trachynion distachyae Rivas-Martínez 1978
Sedetum caerulei Brullo 1975
STIPO-BUPLEURETALIA SEMICOMPOSITI Brullo in Brullo, Scelsi et Spampinato 2001
Plantagini-Catapodion marini Brullo 1985
Ononido breviflorae-Stipetum capensis Brullo, Guarino et Ronsisvalle 1998

SALICETEA PURPUREAE Moor 1958
SALICETALIA PURPUREAE Moor 1958
Salicion albae Soo 1951
Salicetum albo-pedicellatae Brullo et Spampinato 1991

NERIO-TAMARICETEA Br.-Bl. et O. de Bolòs 1958
TAMARICETALIA AFRICANAE Br.-Bl. et O. de Bolòs 1958
Tamaricion africanae Br.-Bl. et O. de Bolòs 1958
Tamarix africana-dominated community

PHRAGMITO-MAGNOCARICETEA Klika in Klika et V. Novák 1941
PHRAGMITETALIA KOCH 1926
Phragmition communis Koch 1926
Phragmitetum communis Koch 1926

Other syntaxa quoted in the text

Ammophiletea Br.-Bl. & Tx. ex Westhoff, Dijk & Passchier 1946; *Chenopodietea* Br.-Bl. in Br.-Bl. et al. 1952; *Crithmo-Staticetea* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952; *Diplotaxion erucoidis* Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936; *Eragrostietalia* J. Tx. ex Poli 1966

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Supplementary material 1

Table S1

Authors: Alfonso La Rosa, Lorenzo Gianguzzi, Giuseppe Salluzzo, Leonardo Scuderi, Salvatore Pasta

Data type: table

Explanation note: Checklist of the Vascular plants observed growing in Parche di Bilello (south-western Sicily).

Link: https://doi.org/10.3897/PlantSociology.58.62437.suppl1